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USSR

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The Rapidity and Methods of Military Roads  
Construction in the Soviet Army During the  
War Period - 1941-1945

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NO. OF PAGES 2

NO. OF ENCLS.

SUPP. TO  
REPORT NO.

25X1

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THE RAPIDITY AND METHODS OF MILITARY ROADS CONSTRUCTION  
IN THE SOVIET ARMY DURING THE WAR PERIOD, 1941 - 1945

1. Conclusions and Observations

a. Concerning the question of the specific role of mechanized transport in Soviet Army operations

In any attempt to determine the specific role of mechanized transport in the facilitation of military operations of the Soviet Army on the territory of the Soviet Union, in particular, and the European theater of war, in general, it is absolutely impossible to approach the subject through the usual methods of material and technical estimates, i.e., on the basis of quite approximate data concerning the transportation of goods in the Soviet Union and an estimate of the percentages of the specific types of transport involved, and to draw conclusions concerning their relative importance. For example, proceeding on this basis, one might infer that since the figure representing the share of motor transport in the over-all annual transport was two percent, it would be logical to assume that its present, post-war share is not higher than 4-6 percent, with further conclusion that, compared with railway transport, its possibilities are very low. However, an analysis of the facts based on the experience of the "Great War" of 1941 - 1945 acts as an important corrective to such a point of view. This viewpoint remains correct if it is a question of so-called strategic transport in the broad sense of the word, but it is incorrect as regards the role of motor transport in the solution of operational problems (within the limits of an army group), and all the more so in the solution of tactical problems (within the limits of separate armies).

Wartime experience for the Soviet side showed that the relatively undeveloped network of railway communications and acute shortage of rolling stock, chiefly, freight and flat cars, completely altered all the former notions about motor vehicle transport as a means of carrying freight over short distances (the 1941 norm for trucks was not more than 60 kilometers from the front line; for horse-drawn loads, up to 40 kilometers). Taking

into consideration, in addition to all this, the great liability (in the first period of the war) of railroad lines and bases to destruction by the enemy from the air, motor transport in a number of cases was the sole means for the conveyance of military supplies and equipment from the home front (200-250 kilometers). In the course of military actions, and more especially, in the preparations for them, simultaneous transport by motor vehicles of entire army groups for distances up to 500 miles took place. In such actions, moreover, not only were the front-line supply bases relocated, but also a significant proportion of the armies' personnel (the transfer of units of the former Don front in February 1943 from the Stalingrad area to the area of the so-called "Orel-Kursk Arc"). On principal sectors of the front (the bridgeheads at the Vistula and the Oder), so-called "motorized kulaks" [fists] were organized by the Soviet command, which, to a large degree, were responsible for the successful conduct of offensive operations, a detailed account of which does not come within the scope of the present subject. Not without interest in this connection are the confidential data of the Engineering Administration of the General Staff of the Army indicating that 400,000 trucks were simultaneously engaged in transport operations at the fronts in the period, 1943 - 1945, with an average maximum run of 100 kilometers, and a quantity of freight moved (including personnel) amounting to 300,000,000 tons. On the whole, insofar as the observations of the author, in the course of activity on separate fronts (army groups), permit, the figure for the share of motor transport in military materiel transport, within a limit of 300 kilometers from the home front to the front lines must be raised to 25-30 percent, and in special instances to 75 percent.

b. The question of the military and administrative solution of the problem of the lack of roads

The decision of the Soviet Government and the Military Command to create a special roads service (in the nature of engineer troops) within the army was not the product of long and careful thought, but appeared as a natural reaction to the problems posed by life itself, when the months of the war made apparent the failure of the usual "sapper"

units and construction and special road exploitation battalions and regiments to ensure the passage of trucks and other types of motorized transport, under conditions imposed by maneuvers and the tremendous extent and depth of the front. The history of the Soviet military road units bears manifest traces of this "administrative breakdown."

The first stage: In September 1941, by an order of the State Committee of Defense (Gosudarstbenny Komitet Oborony), the Administrations of Military Road Works (UVDR) were created and placed under the Gushossdor NKVD, Main Administration of Highways. ~~the Gushossdor NKVD~~ Under the jurisdiction of the latter were placed military road detachments (VDO). Service in the UVDR and the VDO was placed on the same footing as service in the army. The executive personnel was drawn from the administrative and engineering-technical staffs of Gushossdor NKVD or from the territorial (local) Highways Sections of Glavdorup Main Administration of Roads, a civil organization. The rank-and-file personnel was recruited through the local Military Commissariats. Military uniforms (second and third categories), food, and other items of material and technical equipment were supplied from local bases, on request of the Main Administration. The wage scales maintained corresponded approximately to the pre-war scales prevailing for Gushossdor employees. In this connection, wages were also paid to the rank-and-file workers (150-200 rubles a month). The work <sup>was</sup> evaluated according to the Uniform Work Norms (ENV) and the technical accounting followed the peace-time forms.

There does not yet exist a precisely defined table of organization for UVDR and VDO, although there is a breakdown in the latter into companies and platoons. The VDO personnel varies from 400 to 800 men, with temporary assignment to them of militarized "labor battalions" for the execution of urgent, emergency works, such as the construction of the metal overhead bridge across the Sosna River in the city of Yelets in the Winter of 1941 - 1942. The VDO personnel, carrying out this task, numbered 854 men.

Second stage: In June 1942, all six of the UVDRs in existence at this time, with their entire personnel (there were then about 30 VDOs), were transferred from the Gushossdor NKVD to the newly organized Main Administration of Military Roads under the Engineering Administration of the Army, which was renamed the Main Administration of Motor Roads in 1944 (GUAD NKVS, later MVS USSR). The UVDR were renamed ~~etc.~~ VDU (Military Roads Administrations). The VDU and VDO personnel became henceforth an integral part of the active army, with all the consequent rights and duties, such as the provision of clothing and food according to army norms (secondary norms of supply behind the front line and primary norms at the front or in close proximity to it), the acquisition of military ranks, the taking of the military oath, the disciplining rights of commanders of military units, liability to investigation and trial by the military prosecuting office, and courts-martial. A precise table of organization and a table of technical equipment were set up. Pay rates were established for command ranks of the army engineer forces. The rank-and-file and non-commissioned officers were paid according to the scales prevailing for regular military units. The total number of VDUs was raised from six to ten. The VDU and VDO were always considered "reserves of the High Command," subject to operational (tactical) assignments, depending on the requirements of the military situation, to the various fronts (army groups), and even to separate armies (for example, the 3d VDU in 1945 was assigned to the Fifth Shock Army), with the preservation, however, of the territorial situation when possible (the 1st VDU, throughout the war, was maintained in the northwest with the Leningrad and Baltic Fronts (military groups), while the 3d VDU was maintained in the central area on the southwestern, Stalingrad, central, and 1st Belorussian Fronts (military groups)). The territorial dispositions of the VDU and VDO in the first and second stages of their activity, 1941 - 1942, were behind the front, 50-150 kilometers from the front line, and in 1942 - 1943 in the army rear, 20-50 kilometers from the front line.

The third stage: 1943 - 1945, the end of the war. This stage represented the final organization of the military roads units as a combat reserve of "sapper" units. Great stress was laid on specialization in bridge construction. In each VDU, special "bridge construction detachments" were established (officially termed Military, Bridge, and Road Detachment, or VMDO), whose personnel was numerically equal to that of standard VDOs, but differing in their professional aspect. The command staff was composed of bridge construction engineers, and the rank-and-file consisted, mainly, of carpenters and other professional workers familiar with wood and mixed wood-and-metal bridge construction. The "bridge detachments" existing from the very beginning and attached to each VDO (one company to a detachment) were strengthened with especially qualified personnel and reinforced with technical equipment.

They were employed in direct proximity to the front and even at the so-called "bridgeheads," i.e., bridgeheads at river lines (detachments of the 3d VDU were used in operations at the Oder in Germany; the 2d VDU in Berlin, and in Austria). The necessity of the above-named units was dictated by the significant losses among the personnel of the "sapper" units in the course of military operations.

The fourth stage: the transition to peace-time conditions. With the conclusion of military activity in Europe and the partial demobilization of the army personnel, the situation was as follows at the end of 1945:

(1) The transfer of military roads units from former front areas to the Soviet Union. In this connection, the 3d VDU was first sent to the Transcaucasus for the construction of strategic roads on the Turkish border, while two other VDUs were sent to the Far East, to the Manchurian frontiers, for the execution of similar tasks.

(2) The older personnel of the rank-and-file and NCO staffs were demobilized and replaced by cadres of young draftees, partially from former repatriates -- "Ostarbeiter" -- mobilized for military service.

(3) The total number of VDUs was reduced to five, with the following disposition: one oriented toward the European area of the Soviet Union, in the Belorussian area; two in the Caucasus and the Transcaucasus—alternately, on the Turkish and Persian frontiers; and two in the Far East, with the task of building main highways and bridges; the roads were asphalt-concrete and the bridges were of metal and mixed construction, and ferro-concrete sic.

During the entire war period, a peculiar dualism of administrative subordination was preserved in the military road units. Although assigned, for the purpose of securing trafficability of the roads, to the various Fronts (to military groups) and, even, to separate armies, although supplied by these Fronts (military groups) and armies with materiel and food rations, and although subordinate in a definite sense to the Engineering Branch (Administration) of the Staff of the Front, the VDU and the VDO were at the same time directly subordinate to the Main Military Roads Administration, later the Main Administration of Motorized Roads (GUADu) in matters concerning the receipt and execution of orders dealing with transfers (to the Fronts, military groups), changes in the table of organization, the staffing of the units with leading cadres (engineers and technologists), detachment of personnel, technical accounting and instruction. In the post-war period, the VDUs, attached, on a territorial basis, to the appropriate Military Okrug District Administrations and supplied locally with equipment and food rations, saw their dual lines of administrative subordination considerably diminished. Their subordination to the Military Okrug Administrations now consisted only in the maintenance of personnel files, the acceptance of new enlisted and NCO personnel and accounting of supplies and food rations. With the conclusion of a production assignment, their service in a given Military Okrug was usually at an end, and the VDU and VDO were transferred, by order of the Main Administration of Motorized Roads (GUAD), without the slightest hindrance. In wartime, the administrative dualism had a negative significance in

certain cases. Cases of intervention of the Front Command (military groups) and of individual armies occurred in purely technical questions of construction, and there were attempts by individual VDOs to break away from subordination to the VDU, and to assume the status of separate battalions directly subordinate to the Engineering Administration (Section) of the Front Staff (military group).

The very nature of the origin and organization of the VDUs and the VDOs gave rise to a number of special characteristics distinguishing them from the other types of engineering corps of the Soviet Army and even from the former (now dissolved) "highway exploitation regiments." Though they had in their ranks a significant number of experienced and highly competent technical specialists in highway and bridge construction (some engineers in the VDOs have academic degrees for published specialized scientific works), the VDU and VDO were noticeably lagging in problems dealing with the military (combat) training of personnel. Concern with combat training (the study of military regulations, tactics, the handling of personal weapons, etc.) was sporadic in wartime and could not give satisfactory results. For example, the fact that until the end of 1942 only the VDO chief and the four company commanders <sup>may be cited as an illustration.</sup> had personal weapons (pistols). In the entire VDO there were not more than a dozen rifles. After the war, great efforts were made to remedy these shortcomings. Daily drill was introduced among the rank-and-file and the NCO staff, and a combat-training seminar for officers and firing practice. A table of personal arms to be used by the VDU and VDO personnel in wartime was drawn up. (Officers have personal arms in peace time.)

c. The activity of the military roads units in practice

The information available to the author about the 35th Military Roads Detachment of the 3d Military Roads Administration may help, as an example, to define the practical activity of the military roads units.

The 35th VDO was created in September 1941 in the city of Voronezh. Its practical activity extended from October 1941 to July 1945, after which the VDO was sent from Eastern Germany to the Soviet Union to be disbanded.

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In that span of time, the 35th VDO was employed on 16 highway routes with a total length of 1,430 kilometers and on 14 separate targets (the construction of large-scale, multi-span bridges), namely:

- (1) The Voronezh-Ostrogozhsk highway, 100 kilometers in length. Reinforcement of the roadway (at the beginning of the war, construction work on the highway had not been completed); construction and repairs of bridges, designed to bear the weight of 30-ton and 60-ton tanks.
- (2) The Voronezh-Tambov dirt road, 208 kilometers in length, which was given winter maintenance.
- (3) The construction of a metal highway bridge across the Krasivaya Mecha River, 40 meters long.
- (4) The construction of a metal highway bridge in the city of Yelets, 200 meters long.
- (5) The Voronezh-Zadonsk highway, extending 80 kilometers; reinforcement of the highway and modification of bridges to bear calculated weights of 30 and 60 tons.
- (6) The servicing of ferries crossing the Don River in the city of Zadonsk, at the time of the spring floods.
- (7) The construction of underwater wooden bridge across the Voronezh River, 80 and 120 meters long.
- (8) The Michurinsk-Ryazhsk dirt road, extending 100 kilometers, which was cindered and given summer and winter maintenance.
- (9) The Bol'shaya Privalovka-Tambov dirt road, extending 162 kilometers, which was given summer maintenance.
- (10) The Ranenburg—"Lev Tolstoy" Station dirt road, extending 40 kilometers, which was given summer maintenance.
- (11) The reconstruction (reinforcement) of the wooden girder railway bridge at the village, Ilovay-Brigadirskoye, with a total trafficable length of 65 meters.
- (12) The winter maintenance of the Ertil'-Borisoglebsk dirt road, extending 120 kilometers.

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(13) The preparation of elements of the highway bridge across the Don River at the city of Serafimovich.

(14) The winter maintenance of the Voronezh-Gorshechnoye dirt road, extending 70 kilometers.

(15) The Novyy Tim-Zolotukhino dirt road, which was graveled, and given winter, spring, and summer maintenance. Bridges were modified and strengthened to bear an estimated weight of 60 tons.

(16) The building of a wood-construction highway bridge across the Snova River at Zolotukhino Station, whose length of roadway is 150 meters.

(17) The Fatezh-Kromy highway, extending 60 kilometers, which was given summer maintenance; the roadway was repaired and bridges were strengthened to bear an estimated weight of 60 tons.

(18) The Klintsy-Novobelitsa dirt road, extending 75 kilometers, which was given winter and spring maintenance; a paneled road was constructed and bridges were modified and strengthened to bear an estimated weight of 60 tons.

(19) The erection of a wood-construction highway bridge across the Sozh River at the city of Gomel', whose roadway was 410 meters.\*

(20) The repair of the Mozyr'-Ovruch highway, extending 75 kilometers. Tracked and paneled roads were constructed; bridges were constructed and modified (strengthened) to bear an estimated weight of 60 tons.

(21) The <sup>140-kilometer</sup> Kechitsa-Glussk dirt road, where planking was laid out on various sections.

(22) The Kobrin-Brest highway, extending 45 kilometers, which was given summer maintenance; bridges were restored and modified to bear an estimated weight of 60 tons.

(23) The repair of sections of the Sedlets-Miloska Stara highway, extending 70 kilometers. The highway was given summer maintenance, and bridges were modified to bear an estimated weight of 60 tons.

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\* Bridges built in cooperation with other sections of the 3d VDU.

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(24) The construction of the wooden highway bridge across the Western Bug at the city of Drogichin with a roadway length of 350 meters.\*

(25) The construction of the wooden highway bridge across the Vistula at the city of Warsaw, with a roadway length of 500 meters.\*

(26) The Tornov-Berval'de dirt road, extending 40 kilometers, which was given spring maintenance.

(27) The construction of the wooden highway bridge across the Varta River at the city of Landsberg, with a length of 200 meters.

(28) The construction of the wooden low-water bridge across the Oder River at the town of Tsellin, with a length (including the approaches) of 320 meters.

(29) The construction of the wooden low-water bridges at the junction of the Oder and Vorta rivers at the city of Kyustrin — nine units with a total length of 450 meters.\*

(30) The construction of a wooden highway bridge across the Oder at the city of Frankfurt, with a length of 150 meters.

Certain Data on the Volume of Work Completed

1	Dirt roads: constructed	200 kilometers
	shaped	410 kilometers
	improved	100 kilometers
2	Drains laid out	1,070 kilometers
3	Cinder dressing	20 kilometers
4	Crushed-stone surfacing of highways and with local materials	40 kilometers
5	Construction of graveled roads	12 kilometers
6	Holes repaired: bridges	75 kilometers
	asphalt-crushed stone roads	130 kilometers
	crushed-stone roads	120 kilometers
7	Tracked roads	70 kilometers
8	Paved roads	30 kilometers

\* Bridges built in cooperation with other sections of the 3d VDU.

From the quantitative evidence of road projects carried out, their character may be determined and their general trend established as follows:

(1) The avoidance, when possible, of heavy expenditures of materials and projects requiring large capital investment for their execution, and above all, those requiring much time.

(2) The tendency to improve existent roads and not to build new ones; to limit new constructions to temporary types (wooden covering and the use of local materials, in particular, crushed brick). The problem of the military roads units was to ensure trafficability, literally, for a relatively short period of time, and to do everything in the shortest possible time in order that military cargoes might move on the roads without interruption.

Such a solution of the problem was natural and appropriate under military conditions.

Illustrative Information Concerning the Technical  
Equipment of Military Roads Units

In 1941 - 1942, each VDO had on the average: (a) eight ZIS-5 trucks and eight GAZ-AA trucks; (b) three or four towing-tractors; (c) two graders; (d) two road rollers. This was all the road machine equipment. The construction of multi-span, high over-water bridges was carried out with the use of primitive equipment; the pile-driver apparatus did not deliver above 40 or 50 blows a minute; steam-hammers were altogether lacking; and the coefficient of ramming power was exceedingly low.

In 1943, in each VDO there were on the average: (a) twelve ZIS-5 trucks and eight GAZ-AA trucks; (b) ten towing-tractors; (c) six graders;

(d) four road rollers. Improvised triangle-type snow-removers and plows were replaced by mechanical rotary snow-removers. Mechanical pile-drivers (steam hammers) appeared, with an appropriate "head" assembly weighing from 500 to 2,000 kilograms, as well as mobile repair shops equipped with a diversity of instruments and machine tools.

In 1944 - 1945, the number of motor vehicles attached to each VDO <sup>ed</sup> number about forty, on the average, all of them two-, three-, and five-ton ZIS-5 trucks and Studebakers. About six mechanical pile-drivers were at the disposal of each VDO. The mutual assistance /prevailing/ among VDOs, which was required for the fulfillment of specific tasks, plus the motorized units assigned them, served to bring about a considerable degree of smoothness /of operation/.

The higher command, in particular, the Main Administration of Motorized Roads, bore little responsibility for the growth of the technical equipment; the greater part of this equipment appeared in the form of war trophies. In a number of cases, these were seizures independently carried out by the VDOs while passing through the front area, and, therefore, carried the trade marks of French, German, and other firms (mechanical pile-drivers and mobile repair shops). Motor vehicle pools were later stocked in a formal manner, throughout the entire army, which was being supplied with "lend-lease" motor vehicles. The German "trophy" trucks were surrendered and replaced by American Dodges or Studebakers; similarly, at the front, motor pools were supplied home-produced five-ton GAZ-AA trucks, which were gradually turned in as they became unprofitable in military road operations because of their small volume and load capacity, the rapid wearing out of parts, their low roadability on dirt roads in the spring and fall seasons, and the absence of a mechanical dumper for loose freight. As is apparent from the postwar data, the peace-time VDO motor pool (the number of motor vehicles required by the tables of organization) and the bridge construction equipment was reduced in quantity (25 ZIS-5 trucks and 4 mechanical pile-drivers to each VDO), but this is compensated for, in operation, by the rapid notification of shortages in

equipment in the execution of individual assignments, i.e., the rental-use system (arendnoye pol'zovaniye).

During the war, the duration of stay of the military roads units on any one route or objective was reduced. For example, the same 35th VDO, in 1941, serviced two highway routes (3 months) and was transferred only once; in 1942, it serviced four routes and five special targets, with three total and five partial relocations; in 1943, it serviced six routes and one separate target, with six total and three partial relocations, in 1944, it serviced four routes and two separate targets, with twelve total and two partial relocations; in 1945, in a 4-month period, it serviced one route and five separate targets, with eight relocations. Thus, in 1941 - 1942, they transferred, on the average, once every 3-4 months; in 1943, once every 2 months; in 1944, once a month; and in 1945, once every 2 weeks. The figures will be more significant if the increase in the distances involved in the relocations is taken into account. The average distance in 1941 - 1942 was 50-75 kilometers; in 1943 - 1944, from 100 to 250 kilometers. In 1945, the jump from Poland to Germany, involved a distance of 400 kilometers and was made in 5 days, with all the equipment. Throughout the war years, great attention was given by the command staff of the military roads units to the problem of maneuverability (the rapidity of relocation). In view of the fact that the VDO was burdened with heavy, motorless, slow-moving equipment, and the long-felt shortcomings in motor transport facilities, it is easy to understand the complexity of the problem to be solved. Approximative (variant) plans were elaborated for operative (rapid) relocation, envisaging minimal expenditures of transport facilities for "damage-repair" operations, such as snow removal on the roads in winter, the clearing of roads during the spring and autumn when the roads become mired. According to these plans, the problem was solved through the "method of small forces." Simultaneously, with the receipt of an order for the transfer of any unit to the site of new "damage-repair" operations, a so-called "operational group," in several of the best vehicles, equipped

with everything necessary in the event of repairs or fueling on the road, was dispatched in advance and sometimes much earlier than the arrival of the main VDO forces. The numerical strength of the operational group depended on the concrete situation and the nature of the task, but of necessity it remained comparatively small, and was strong only in the quality of its men (the best officers, sergeants, and enlisted men). On arrival at the emergency site, this group was responsible for swiftly eliminating the threatening state of affairs and concentrating their forces on the most difficult trouble spots that required the quickest repairs. However, in no case were they to scatter over the whole site (the matter concerned a highway, for example), but they were to proceed along it in a previously determined direction. Usually, under the wartime labor conscript system, the available civilian population in these areas was enlisted for road maintenance operations (the ensurance of trafficability). Arriving at the road site, the basic VDO forces began to distribute themselves from the opposite end of the highway, so as to meet with "operational groups." Experience clearly dictated such a solution. It was, indeed, in this manner that the danger of failing to fulfill a battle order and even the nullification of military operations at a number of road sectors was avoided.

The most effective and expedient methods of distribution along the road sectors were gradually worked out. The desirable extent of a road sector to be serviced by one VDO on dirt roads, which are characteristic for military operations on USSR territory, did not exceed 70 kilometers. The usual disposition of a VDO on a road sector may be outlined as follows: Somewhere -- approximately, in the center of the road sector -- the VDO staff was stationed, with the 4th (automobile mechanics) Company attached to it, the latter charged with the task of furnishing transport services, administrative help, and supply dumps to all the other VDO subdivisions. Each road company (3 in all) serviced a section of the road, averaging 20-25 kilometers. Thus, each platoon was responsible, on the average, for a road sector of 5-7 kilometers (25-30 troops to a platoon). The

dispositions of the companies and platoons were subject to change even in the servicing of a single highway route. During the stay of a VDO on a given route, according to the degree of need, partial relocations might occur, which were particularly frequent in the case of platoons that had been combined with other platoons for the execution of some recurrent, urgent operation on a small road sector. In the matter of winter maintenance of dirt roads, experience showed the expediency of a timely erection of fixed snow defenses in the form of braided brushwood and screens along the entire road on both sides, excluding sites with high embankments and populated areas. This was true, above all, in the central belt of the European part of the USSR, with its strong winds and high snowdrifts. In the absence of materials for the construction of brushwood fences and fixed snow screens, the same problems might be solved through the erection of snow walls and embankments either by hand or mechanically (with the aid of snow plows). Along road sectors likely to be snowed in, a duty-service was organized, with snow-removal equipment, with a servicing norm, in the case of tractor-drawn snow plows, of 15-20 kilometers of road, and 5 kilometers in the case of horse-drawn "triangle" plows. In this connection, the presence on one and the same road sector of both types of plows was not impossible, since the horse-drawn plows had the primary function of daily "preventive clearing" of small drifts, more exactly, the prevention of the formation of bulges and obstructions by the snow. Heavy-tractor apparatus or rotor-type snow plows were used for the removal of the consequences of a protracted snow storm and deep drifts across the trafficable part of the road.

## 2. Cinder and Other Dressings

In the complex of military road operations whose task and limited objective was the ensurance of trafficability along the motor roads in the shortest possible time and with the minimum expenditure of men and materials, a role of special importance was assigned to road covers consisting of so-called "local materials." These included sandstone, soft limestone, crushed stone and sand mixtures, broken brick, and furnace

were needed, in the neighborhood of Khobotovo Station, which was also in the immediate vicinity of the road, without the necessity of constructing special access routes.

It was decided, in the first instance, to apply cinder dressing to a 9-kilometer sector of the road to a depth of 20 centimeters ( $0.20 \times 8 \times .75 \times 8,000 = 9,600$  cubic meters); sand was used in the following proportions:  $0.20 \times 8 \times .25 \times 8,000 = 3,200$  cubic meters.

Thus, a total of 12,800 cubic meters of local materials was required for construction.

The organization of the work may be outlined in the following way:

At the Kochetovka Station site, two so-called "shuttles" were in operation, feeding the cinder supply as close as possible to the site of the road work. This was a combination of two separate railroad flat-car assemblies, each one in turn being moved along a narrow-gauge siding by a switch engine, in a continuous operation. The "shuttle" could transport 160 tons of material in one trip (each assembly loading and unloading once). Two shifts, working 10 and 6 hours, respectively, handled the loading and unloading operations in two groups of 20 troops each on the flat-car assemblies with a norm of 20 cubic meters of slag for each group in a ten hour working day (loading the material on the flat cars and unloading it into trucks).

In the latter operation, they were assisted by the troops assigned for the servicing of the trucks (one to a vehicle).

Twelve cargo trucks transported the cinders to the road site, with a norm of 20 trips over an average distance of 3 kilometers in 16 hours. The movement of 9,600 cubic meters of slag was accomplished in 16 days, i.e., an average of 600 cubic tons a day.

Seven cargo trucks were engaged in conveying sand to the road site, with a norm of 12 trips over an average distance of 5 kilometers in a 16-hour period. The movement of 3,200 cubic meters of sand were fulfilled in 15 days, by increasing the number of trips (the Stakhanovite method), i.e., an average of 215 cubic meters a day. This was above the daily norm required for mixing the material with the cinders moved to the

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road site (600 cubic meters), the norm being 150 cubic meters. Thus, a reserve of sand was accumulated at the work site.

Two shifts (10 and 6 hours, respectively) were engaged in loading operations at the sand pits, which were of the open type, each shift employing 16 troops, with an individual norm of 9 cubic meters of sand per 10-hour day.

A light grading of the roadway with a grader (the restoration of the grade was achieved by going over four times with a "GL" grader) and the construction of a curbing of crushed rock preceded the cinder dressing operations. Two platoons (40 persons) were engaged in spreading the slag, in which connection the so-called "conveyer" method, for the increased scale of operations, was employed, although only partially, i.e., the troops were subdivided into several groups (sections), each work team following the other in succession. Thus, at the time, for example, that the third group was distributing the cinders (evening them out), the second team mixed cinders and sand and spread the mixture on the next section of the road, while the first team marked off the surface of the roadway further ahead (set up guide markers), continuously preparing each successive section of the road in the same way. A part of the same troops went ahead to build the curbing.

The cinders were spread in two layers, 10 centimeters in depth each, with a light roller (5 tons) rolling each layer and a medium motorized roller (7 tons) rolling it a second time, going over it 7 to 12 times. Water was poured on the cinders at the same time.

The first 8 kilometers of cinder dressing were done in 18 days, with two shifts of road workers, i.e., an average of 440 meters of road per day, or 11 meters for each worker per 10-hour shift. The work on the remaining 12 kilometers was carried out at the same rate and was completed on the 15th of September. Subsequently, the depth of the cinder layer was increased in places to 25 centimeters.

In the September-November period the section dressed with cinders gave full satisfaction, subjected to a daily flow of motor-vehicle

columns averaging 1,000 vehicles, as against the usual volume of 100-200 vehicles daily for an unimproved dirt road.

The period of the autumn thaws passed without consequences, in the sense of reduced trafficability. Subsequent observations showed the necessity, in the case of extended use of previously dressed sections, of preventive repairs by filling in separate sections of the roadway and additional rolling. As it turned out, a part of the covering was carried off by the wheels of passing vehicles, leading to the appearance of track marks and "bald spots" on the roadway. These defects, with a little effort, were eliminated in the course of day-to-day maintenance. Many roads at or near the front were dressed with crushed brick, available in large amounts as a result of military activity in the neighborhood of populated areas.

Reconstruction work was undertaken in the Summer of 1943 on a sector of the Fatezh-Dmitriyev L'govskiy road (40 kilometers), with the preliminary laying down of a sandy layer, 20 centimeters deep, along the grade of the roadway. The crushed brick was scattered, evened out and rolled, unlike the usual temporary covering with analogous material, in a single layer 10 centimeters deep, with brick fragments of about 50 millimeters, and a supplemental covering of brick fragments and slaked lime, as well as an outer covering of gravel. The rolling of the surface with powered rollers, first with a light roller and then with two medium rollers, was carried out in the same way as on the cinder-dressed roads.

The brick dressing operations on the above-mentioned road sector employed two roads companies (150 workers) with the division of the sector between them into two approximately equal parts, in terms of extent and the amount of work involved.

Forty vehicles from a motorized regiment were assigned to assist in the movement of the crushed brick and sand from the open pit, with an average daily norm of 16 trips over a 5-kilometer distance.

In the preparation of the crushed brick and the loading and unloading operations, 45 troops were employed; 105 persons were used in

the road-dressing operations. Labor productivity averaged 9 meters of covering per man per day (in a 10-hour shift). Thus, 945 meters of road was dressed each day. In the transport work, trucks with mechanical dumping devices were employed.

### 3. Gravel Roads

The classification of "capital road-construction work," which occurred during the war, includes, first of all, the construction of light-duty gravel roads with an estimated endurance of not more than five years under continuous use. The majority of these roads were built in small sections not exceeding 20-30 kilometers. The data cited below deals with one such construction project carried out on the Novyy Tim-Zolotukhino military route, in the "Orel-Kursk Arc" area in May and June of 1943.

The sector of the dirt road in the environs of the village of Mokhovoye, was found to be in a highly unsatisfactory condition during winter maintenance work (snow drifts), with damage done by the spring thaw (deep mud holes). In order to prevent decisively a threatening situation in the future, it was decided to undertake the construction of a gravel road along a 12-kilometer section with the advent of steady summer weather. Thirty workdays were assigned for the completion of the task. Carrying out the work was a military-roads detachment (three companies) and two truck battalions assigned them from a motor pool to assist in the movement of materials.

The basic operations consisted of the following:

- a. The construction of an embankment averaging 3 to 5 meters in height along the entire sector of the road;
- b. the construction of a drain;
- c. profiling, with the construction of curbings and ditches;
- d. the rolling and packing of the dirt subroadway;
- e. the construction of a "trough," with a hard cover;
- f. the construction of a sand foundation 20 centimeters thick;
- g. the preparation and transport to the work site of construction material: 14,400 cubic meters of gravel (crushed stone) and 19,200 cubic meters of sand;

h. the spreading of a single layer of gravel, 15 centimeters thick;

i. the profiling and packing of the finished surface.

For the execution of the work, the VDO had at its disposal 290 persons -- troops belonging to the road companies -- 50 trucks with automatic dumpers, and 54 trucks without such dumpers. The following equipment was employed:

2 "GS" graders

3 light and medium motor rollers

6 belt conveyers

4 ChTZ tractors

Besides that, 12 cars were employed on a narrow-gauge railway, traveling parallel to the construction site, plus wheelbarrows, tampers, and other light construction equipment.

The distribution of labor was as follows:

a. 80 troops were employed in loading and unloading work at the "open" pits;

b. 150 troops were employed in earth operations;

c. 60 troops were employed in gravel spreading with the preliminary construction of a sand foundation;

d. In the transport operations, 40 trucks were employed to deliver gravel to the construction site over a distance of 10 kilometers, with a norm of 10 trips per 10-hour working period; 64 trucks were employed to deliver sand over a distance of 8 kilometers, with a norm of 10 trips per 10-hour working period.

It was decided to construct a crescent-shaped profile, with a roadway 8 meters wide, dirt shoulders 1.5 meters wide, and drainage ditches 1 to 1.5 meters wide.

The "conveyer method" of production was to be applied with all the possible operations performed simultaneously in a successive series. The working day was 10 hours.

The task of constructing a 12-kilometer sector of gravel road was carried out in the designated period of 30 days, with the completion of

transport operations in the delivery of sand in 20 days, and of gravel in 24 days. The earth work was to be completed in 20 days, and the gravel surfacing in 20 days.

The Volume of Basic Operations Completed

- a. Earth works -- 36,000 cubic meters
- b. Sand moved, spread, and rolled -- 19,200 cubic meters
- c. Gravel transported, poured, and rolled -- 14,400 cubic meters
- d. Gravel surfacing -- 12,000 cubic meters, in a layer 15 centimeters thick

The labor productivity was as follows:

- a. Loading and unloading operations involving the use of conveyors -- 20 cubic meters per man per 10-hour day;
- b. Earth operations (medium soil) carried out by hand -- 12 cubic meters per man per 10-hour day;
- c. Construction of the gravel cover, 10 meters of finished road per man per 10-hour day.

The road surface performance gave fully satisfactory results in subsequent use. The first major repair [~~the filling of holes~~] of the sector occurred in 1945.

4. Tracked and Paneled Roads

Under conditions of total or partial impassability on roads, with a dangerous interruption of movement, in marshy and wooded areas, temporary light, portable, sectional wooden tracks and road panels, quickly and inexpensively assembled, rendered a great service to Soviet Army operations. Their total extent in the European territories of the Soviet Union during the war was measured in hundreds of kilometers. During the war, through practical experience, a study of the best methods of construction and a selection of the most expedient designs were made. Altogether 40 types of designs were employed during the three-year war period.

An approximate classification of various construction designs was established, depending on the type of movement and the kind of soil.

According to this classification, the construction of a tracked road

out of logs or wooden beams (the latter, in the event of proximity to a sawmill) was recommended for intensive motor vehicle movement (up to 500 vehicles a day) in heavy or marshy soils: in the last instance, a timber flooring (paneled road), on reinforced foundations, was recommended for mixed traffic, including caterpillar-tread transports (also on heavy or swampy soils).

On the Klintsy-Novobelitsa, Mozyr'-Ovruch, and Rechitsa-Glussk military routes, 70 kilometers of timber tracked road (two-way) were constructed by one military roads detachment.

The tracked road in one instance employed plank or board construction and in the other beam (nakatnik) construction. In both cases, they were built with holding clamps, not made of metal, having the following dimensions: .75 - 1.00 - .75 meters, totaling 2.5 meters, and with wheel guides. Construction of tracked roads was carried out on the surface of the soil, outside of the trafficable part of dirt roads or highways already in existence in certain places. This was done with the aim of providing additional traffic routes and also in order to avoid traffic blocks during necessary repair work on the roadway sectors of the basic routes.

Paneled roads employed plank construction, with transverses angled diagonally to the flooring, and panels 3.2 x 4.2 meters in size.

This type of road was also built alongside of primary roads, on the ground surface. The dimensions noted, for tracked as well as for paneled roads, were used not only out of consideration for the ensurance of intensive transport movements, but also for the facilitation of transport of the structural elements to the installation site (the weight of a panel could not exceed 400 kilograms). In the construction of paneled roads, the junctions of the panels were arranged in such a manner that the wheels of the vehicles should rest simultaneously and continuously on two contiguous sections of the paneling. In this way the weakest point in the construction of paneled roads, i.e., the disruption of

the junctions, was circumvented. This occurred especially frequently where the foundation was weak or where the paneling used was very thin. (The required thickness of the panels ranged from 4 to 7 centimeters.) Stakes 0.7 meter in length and 10 centimeters in thickness were driven on both sides in checkerboard fashion three or four to a panel, to secure the panel in place and hold it from shifting under the passage of vehicles. When time permitted, flanges were constructed out of planks or beams along the sides of the assembled panels, to prevent the vehicles from skidding off the road.

The construction of a tracked road involved the following operations: (a) the procurement and processing of materials (beams, stakes, and wheel-guides) on the site, in wooded areas; (b) the preparation of a foundation for the tracked road (earth operations); (c) the transportation of prepared materials to the construction site in accordance with the planned schedule (operations plan); (d) the assembly of the structural elements on the site. In the construction of paneled roads, the latter process consisted in the assembly of the shields and the reinforcement of the assembled road.

In all construction of tracked and paneled roads, great attention was paid to the regulation of movement (the erection of road markers, the assignment of troops to direct traffic, etc.). Sometimes the timber flanges and outside wheel-guides were painted white so that the roadway might be more easily identified.

Work on the construction of a road was carried out by companies and by platoons, while special teams prepared and transported the materials.

The preparation and grading of the earth foundation is executed by a "GL" grader, or manually by a force of 10 to 25 troops. The assembly of the panels is carried out by groups of six men when the road is constructed from one end, and by 10-man groups when the section is simultaneously built from both ends. The assembly of the connecting cross beams is done by groups of four and five, and the construction of

wheel-guides or flanges by groups of two or three men. The reinforcement of the panels and tracks is carried out by groups of six. Each group was assigned daily a definite section to be completed.

Labor productivity attained on the construction of tracked and paneled roads may be judged by the following data:

a. On highway No 1, a single VDO company (85 persons) constructed 0.6 kilometer of two-way paneled road daily, and 0.8 kilometer of one-way tracked (planked) road.

b. On highway Nos 2 and 3, these same forces built daily 0.5 kilometer of tracked road employing poles.

In the above example, the time employed in preparatory work on the foundations of the road was included.

##### 5. Log Roads

Whenever it was necessary to establish trafficability for military transportation in the shortest possible time in wooded and marshy areas, the simplest type of temporary wooden covering, logs or poles, may be employed. The construction principle consists in laying, across the designated section (the traffic course) -- frequently, with a primitive type of surface preparation of the soil ("roadbed") -- unpeeled "bolsters," averaging 3 to 5.5 meters in length and notched for the subsequent laying of the log flooring. The "bolsters" are laid in parallel at a distance of 2 to 2.5 meters. Poles averaging 8-9 meters in length are laid lengthwise in the notches with minimum "play" and in staggered order to provide the most rigid structure. They are secured to each other at the ends by a "tongue and groove" lock (the groove is half the diameter of the pole). In the second variation, a transverse flooring is laid, in which longitudinal bolsters, 6 to 6.5 meters long, are laid down along the projected route, in series of three, with one-meter intervals between them. Poles 3 to 3.5 meters long are laid across the bolsters. In both variants, the poles are fastened to the bolsters by means of wooden pegs; and in the second variant, the ends of the bolsters are

locked by a tongue-and-groove joint. The sides of the flooring are strengthened by wooden stakes in checkerboard fashion at intervals of .5 to 1 meter. The service life of the flooring is short, but that is compensated by the rapidity of its construction. To facilitate traffic and to lengthen the service life of the flooring, it is recommended that it be covered on top with a sandy soil. The allowable traffic load must not exceed 250 vehicles a day. Overloading is permissible only for the shortest periods (on highway No 3, the daily vehicle traffic over the pole flooring, numbered 800 motor vehicles a day for three days prior to the offensive launched by (military groups) the First Belorussian Front, after which the road was abandoned.

Labor productivity in the construction of log roads may be judged from the following data:

12.6 kilometers of log road was built in six days (with a 12-hour working day) by one VDO force (three companies of workers numbering 270 persons), with an average of 7 to 8 meters per man per day.